REMARKS

The outstanding Office Action addresses and rejects claims 1-19. Applicants respectfully request reconsideration of the present application in view of the amendments set forth above and the remarks below.

The specification has been amended as suggested by the Examiner to include references to Figure 1 on pages 22 and 28.

Claim 1 has been amended to clarify that the step of varying the dose of delivered radiation is performed to optimize the development process. Claim 13 has been amended to delete repetitive language. Claim 19 has been canceled. Support for these amendments can be found throughout the specification and drawings, in particular at page 13, lines 21-24; page 32, lines 12-15; and FIGS. 12a – 12c. No new matter has been added.

Claim Objections – Double Patenting

The Examiner objects to claim 19 as conflicting with claim 12 of Application No. 09/922,973. Claim 19 has been cancelled by amendment.

Claim Rejections – 35 U.S.C. § 112

Claim 13 has been rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. In particular, claim 13 is repetitive.

Claim 13 has been amended to comply with the proper claim format.

Claim Rejections – 35 U.S.C. § 102

The Examiner rejects claims 1-6, 10, and 12-18 pursuant to 35 U.S.C. 102(b) as being unpatentable over U.S. Patent No. 5,182,056 to Spence et al. ("Spence"). In particular, the Examiner states that Spence teaches a stereolithographic method which comprises first forming a first resist layer; exposing the layer to form gelled and un-gelled portions; coating a second layer

of resist and exposing it to form second gelled and un-gelled portions. In addition, the Examiner asserts that the reference teaches varying the dose to control the exposure in overlapping areas (citing Fig. 26 & 15; 18-45).

Applicants respectfully disagree.

The present invention provides a method for optimizing the *development* of a multilayered resist by varying the dose of radiation delivered to a least one region of a second or higher order layer. For example, this method can prevent excessively long development times and minimize resist loss in unexposed portions. In positive tone resists, the degree of solubility into a given developer will typically depend on the exposure dose. Since the resist is semitransparent at the given exposure wavelength, the dissolution rate decreases with depth. If a constant exposure dose were used, development would proceed rapidly at the beginning of a layer, but slowdown near the bottom of the level. Development times would therefore become excessive in multilayer applications since the overall development time would be substantially equal to the time required to develop through one layer times the total number of layers. Compounding this problem, excessive development times in multilayer resist applications can lead to a loss of dimensional control.

To reduce the development times, the present invention provides techniques using *higher doses over portions of a layer*. Moreover, in another aspect of the invention, the dose delivered to a region of a layer is based, at least in part, on the dose delivered to a corresponding region of another layer. For example, using higher doses within the central portion of the structure causes development to advance more rapidly within the interior of the structure and proceed more uniformly towards the perimeter of the part. Overall development times are reduced significantly compared to the more limited top-to-bottom development process that occurs when uniform doses are used.

Spence generally relates to stereolithographic apparatus which can generate parts by successively solidifying a plurality of thin layers of a solidifiable fluid-like medium by exposure to a beam of radiation. By using a beam of radiation having different wavelengths, a plurality of

depths of penetration is provided. As shown in FIG. 26 (the Figure cited by the Examiner) a beam of radiation that contains different wavelengths results in some portions of the beam penetrating deeper than other portions *of the beam.*

Nowhere does Spence disclose varying the dose of radiation delivered to any region of the second layer based on the dose delivered to a corresponding region of the first layer. Spence discloses a beam of radiation that provides a varied depth of penetration, but the strength of the beam itself is not varied across different regions of a layer to provide a variation in dose. In addition, Spence does not adjust the dose delivered to the second layer based on the first layer. In fact, since only the beam itself is varied, it is not clear that Spence even has the ability to make adjustment to a region of the second layer based on the corresponding dose delivered to the first layer. In the present invention, by varying the dose delivered to the second layer, a corresponding region of the first layer, which is preferably under-exposed, receives the desired exposure. Spence completely fails to disclose this concept.

In addition, Spence does not perform any *development step*. In Spence, a part is manufactured by successively dipping a platform into soluble resin and then exposing some of the soluble resin with a radiation beam to create a layer of solidified resin in a desired pattern. The process is complete when the desired number of solidified layers has been stacked. No development step is used because the unexposed resin remains soluble and can be drained away. Spence therefore fails to teach or disclose any development step, and the inclusion of any such step would be counterproductive.

Spence similarly fails to disclose the limitations of independent claim 18. Claim 18 requires a method of efficiently patterning interior portions of a multilayered photoresist perform. The method including exposing the second layer to a second modulated dose of radiation energy, the modulated dose being varied as a function of a relative spatial location of the first and second portions. The dose being greater for interior portions. Spence fails to teach or disclose any relationship between dose modulation and the interior portions. Even if the variation of penetration depth created with Spence's radiation beam were considered dose

modulation, there is no disclosure of increasing the dose to interior portions, or varying the dose as a function the spatial location of the first and second layer.

Applicants therefore believe independent claims 1 and 18 are allowable, and dependent claims 1-17 are allowable at least because they depend from an allowable base claim.

Claim Rejections – 35 U.S.C. § 103

The Examiner rejects claims 7-9 and 11 pursuant to 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,182,056 to Spence in view of non-patent publication Gale et al. ("Gale") and further in view of admitted prior art. In particular, Gale is cited to teach using a positive tone resist, baking the resist, and developing the resist after exposure.

Gale discloses an entirely different, and conflicting process from Spence and therefore the teachings of Gale cannot be applied to Spence. Gale is directed to a laser writing system for the fabrication of continuous-relief micro-optical elements in photoresist. All the fabricated optics appear to be one layer in thickness. As discussed above, Spence builds up a part by successively dipping into a vat of resin and solidifying some of the resin layer by exposing the resin with a beam of radiation. Spence is specifically directed to negative tone resists, and to solving difficulties with the negative tone resist processes. Substituting the positive tone resist of Gale would conflict with the teaching of Spence and would only be possible by contradicting Spence's own disclosure.

Similarly, there is no need for Spence to develop the resist. The unexposed portions of the resin in Spence remain soluble and can be removed without the need of a developer. Neither reference contains any motivation to develop the resist in Spence, because this step is unnecessary and possibly damaging. Spence and Gale therefore cannot be combined to teach the limitations of the pending claims.

To teach the use of DNQ/novolac based resist, as required by claim 11, the Examiner cites the Applicants' own specification. Applicants disagree, the specification does not contain

any admission that these limitations are found in the prior art. Regardless, the claim is allowable at least because it depends from an allowable base claims.

Conclusion

Applicants therefore believe that claims 1 and 18 are patentably distinct from the prior art, and dependent claims 2-17 are allowable at least because they depend from an allowable base claim. Allowance is therefore respectfully requested.

The Examiner is urged to telephone the undersigned Attorney for Applicants in the event that such communication is deemed to expedite allowance of this application.

Respectfully submitted,

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